

Assessment of Quality of Life as a Tool for Measuring Morbidity Due to *Schistosoma mansoni* Infection and the Impact of Treatment

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Abstract. Recently, health measurements have broadened to include the assessment of quality of life (QOL). This study was conducted to assess whether the short form of the World Health Organization (WHO) QOL questionnaire (WHOQOL-BREF) was an effective tool for measuring morbidity due to *Schistosoma mansoni* infection and whether it could detect an impact of treatment with praziquantel. A total of 724 adults 18–85 years of age were enrolled. At baseline, *S. mansoni* prevalence was 73.2% by stool examination and 75.4% by circulating cathodic antigen, and there was no association between infection status and WHOQOL-BREF scores. Six months after treatment, *S. mansoni* prevalence was lower and the proportion of persons with higher WHOQOL-BREF scores significantly increased among persons who were infected at baseline. However, a similar increase was observed in persons not infected at baseline. In areas of high prevalence, the WHOQOL-BREF may not be able to detect the benefits of schistosomiasis control programs.

INTRODUCTION

Schistosomiasis, which is caused by infection with *Schistosoma* spp., is one of the most prevalent parasitic diseases in the world. An estimated 207 million persons are affected worldwide, and more than 20 million persons have severe disability associated with the disease.¹ A formal recognition of the global burden of schistosomiasis was given in 2001 with World Health Assembly Resolution 54.19, which called for the periodic treatment of high-risk groups to reduce morbidity and mortality associated with schistosomiasis.² Although a treatment directive was put in place, there were no clear guidelines presented for defining reductions in morbidity or how best to implement schistosomiasis control programs.

Early in schistosomiasis control, measurement of the public health impact focused on quantifiable morbidities, such as hepatosplenomegaly or hepatic fibrosis.^{3–5} However, many infected persons may not experience advanced stages of disease but are still likely to have less obvious, but persistent disabilities such as anemia and impaired growth. Consequently, some schistosomiasis control programs began to incorporate measurement of subtle morbidity markers.^{6,7} Although unlikely to cause severe outcomes, such as death, the presence of subtle morbidities may have a significant impact on important activities of daily life, including the ability to learn or work. However, these subtle morbidity markers are often difficult to measure and are not unique to infection with *Schistosoma* spp.^{8,9} To better monitor and evaluate treatment programs, improved tools for assessing schistosomiasis-associated morbidity are needed.¹⁰

Currently, the benefit of treating *Schistosoma mansoni* infections is monitored primarily by assessing changes in infection prevalence and intensity. This monitoring is commonly performed by stool examinations, which are often difficult to perform and may not truly reflect the impact of treatment on health.^{11–14} Recently, health measurements have broadened beyond traditional morbidity and mortality indicators to include the assessment of the impact of disease

on perceived health, and several instruments have been developed to measure quality of life (QOL). Many of these standardized instruments have been used to assess QOL related to infectious and chronic diseases and have been used in different cultural contexts.^{15–17}

Although the QOL instruments have been used widely in many settings, relatively few studies have examined the effects of schistosomiasis on perceived QOL. In one study conducted in Egypt, a significant relationship between severity of schistosomiasis and QOL was reported,¹⁸ and similar findings were described in China.¹⁹ However, the impact of these studies was somewhat limited by the absence of an uninfected comparator group. Other studies that have included uninfected comparator groups have reported variable results.^{20–22} Furthermore, there have been no published reports that examined the effects of treatment of schistosomiasis on QOL. Therefore, we conducted a study to evaluate the effects of *S. mansoni* infection on perceived QOL in a village eligible for mass drug administration for schistosomiasis. The study was conducted to assess if a standardized QOL instrument was an effective tool for measuring morbidity caused by schistosomiasis and whether it could detect an impact of mass treatment with praziquantel.

MATERIALS AND METHODS

Study setting and population. The study was conducted in the village of Usoma, a community adjacent to Lake Victoria near Kisumu in western Kenya, an area in which malaria, *S. mansoni*, and soil-transmitted helminthes are endemic. Many persons living in this area use lake water for daily activities such as bathing and washing, and high rates of *S. mansoni* infection have been reported.^{23–25} In addition, occupational activities can often require extensive contact with lake water, which presumably puts persons at a higher risk for infection. For example, men who work as sand harvesters or car washers have a high prevalence of *S. mansoni* infection,^{26,27} and a recent study conducted in Usoma reported 55.6% of school age children were infected with *S. mansoni*.²⁸ Current World Health Organization (WHO) guidelines for schistosomiasis control recommend mass treatment of communities with praziquantel when infection prevalence is greater than 50%

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among school age children. Although high rates of *S. mansoni* infection have been reported in Usoma and the surrounding areas, no mass drug administration with praziquantel in the adult population had been carried out before our study.

We attempted to enroll all eligible adults (≥ 18 years of age) living in Usoma in our study. According to a population census conducted in 2008, approximately 790 adults were identified as residents of the community. Because persons who had received treatment for schistosomiasis in the past may have formed opinions about the effects of treatment, adults with a history of prior treatment were excluded from the study but not from further treatment. In addition, because pregnancy may affect perceived QOL, pregnant women were also excluded from the study.

Ethical considerations. The study protocol was approved by the Scientific Steering Committee and the National Ethical Review Committee of the Kenya Medical Research Institute and the Institutional Review Board of the Centers for Disease Control and Prevention. The study was explained to potential participants and written informed consent was obtained from persons who agreed to participate. All identifiable information was kept confidential and maintained by using a secure database with access restricted to essential study personnel. No personal identifiers were included in the analysis dataset.

Baseline data collection. Enrollment began in November 2009. The enrollment process for participants involved four separate visits. An effort was made to complete all visits within a one-week period. On the first visit, persons were briefed on the study and given an opportunity to enroll. Upon enrollment, study workers orally administered a series of questionnaires to each participant. At the second visit, blood, urine, and stool samples were collected, anthropometric measurements were taken, and treatment with praziquantel was given. The third visit consisted of only stool sample collection, and the fourth visit consisted of a treatment tolerance questionnaire and final stool and urine collection. Details of the information collected at each visit are given below.

Demographic data collection and questionnaires. After obtaining informed consent (first visit), questionnaires were administered to participants to collect desired information. A screening questionnaire was administered to determine eligibility for the study. If eligible, questions were asked to collect basic demographic information such as age, sex, and marital status. In addition, heads of households were asked questions to assess asset ownership, utilities, house construction, crowding, and education level to estimate socioeconomic status. Finally, using the short form of the WHO QOL questionnaire (WHOQOL-BREF), each participant was asked a series of questions to assess perceived QOL. The WHOQOL-BREF was designed to provide a standardized measure of QOL, not only within similar cultural contexts, but also across different cultural settings. It contains 26 questions and provides scores for each of four domains (physical, psychological, social, and environmental). Two of the 26 questions assess a person's overall perception of QOL and health and are not included in scoring the four domains. Scores range from 4 to 20 for each domain and are scaled in a positive direction; higher scores denoted higher QOL.²⁹ The questions were translated into the local language of DhoLuo according to specific WHO guidelines. The translated questionnaire was pre-tested in a community near Usoma, which was chosen because of its similarity in characteristics to the study village.

After the translation was finalized, the questions were not altered in any way when administered to the participants. Scores for each domain were calculated according to the specific WHOQOL-BREF instructions. Two days after treatment (fourth visit), participants were asked questions related to tolerance to praziquantel. Persons were asked to acknowledge the presence or absence of 10 specific side effects. If a particular side effect was experienced, participants were asked to rate the severity as mild, moderate, or severe, and values were assigned according to the response. If the side effect was absent, the assigned score was zero; if mild, one; if moderate, two; and if severe, three. All side effects were weighted equally. A composite score was created to represent severity of side effects.

Anthropometric measurements. Although not typically collected for adult populations, anthropometric measurements were taken. Height was measured to the nearest cm and weight to the nearest 0.1 kg by using a digital scale (Ashton Meyers; Middlesex, UK). Mid-upper arm circumference was always measured on the right arm and was recorded to the nearest millimeter.

Blood collection and diagnostic tests. At the second visit, blood was collected via a single finger stick. To assess anemia, hemoglobin levels were measured using a portable, battery-operated hemoglobinometer (HemoCue, Angelholm, Sweden) according to manufacturer's specifications. Anemia was defined according to the Kenyan clinical guidelines as a hemoglobin level < 12 g/dL for women and < 13 g/dL for men. Severe anemia was defined as a hemoglobin level ≤ 8 g/dL for men and women.³⁰ Malaria infection status was determined by preparing thick blood films and using standard Giemsa staining techniques. Slides were examined by trained microscopists to determine malaria parasitemia. Positive infection was defined by the presence of one or more malaria parasites in 300 high-powered fields. Approximately 100 μ L of blood was collected into a 1.5-mL microcentrifuge tube for transport back to the laboratory where serum samples were separated by centrifugation. Serum was stored at -20°C until tested for antibodies against schistosome by using the schistosome adult worm protein-specific enzyme-linked immunosorbent assay (ELISA). Positive antibody results were defined by using established values.¹²

Testing for human immunodeficiency virus (HIV) was conducted for consenting persons. Trained HIV counselors provided pre-test and post-test counseling to all persons who consented to testing. Each sample was evaluated by using two independent rapid tests (Alere Determine™ HIV-1/2; Alere Inc., Waltham, MA and SD Bioline HIV-1/2; Standard Diagnostics; Kyonggi-do, South Korea). For discrepant results, a third assay (Uni-gold Recombigen® HIV; Trinity Biotech, Ireland) was conducted as a tiebreaker. The counselors provided results to the participants. Persons positive for HIV were referred to the Kisumu District Hospital for care.

Urine collection and diagnostic tests. Urine samples were collected pre-treatment and two days post-treatment to measure schistosome circulating cathodic antigen (CCA) levels. The CCA tests were performed in the field by using a commercially available rapid test (Rapid Medical Diagnostics, Pretoria, South Africa) and were conducted according to manufacturer's instructions. Results were measured on a graded scale and were recorded as negative, 1+ (low positive), 2+ (moderate positive), or 3+ (high positive).

Stool collection and diagnostic tests. Stool was collected to quantify *S. mansoni* infection status by using the Kato-Katz fecal thick smear technique.³¹ An attempt was made to collect fresh stool samples, one per day on three consecutive days. Samples were used to prepare duplicate slides that were examined for *S. mansoni* eggs. Each slide was read independently by two trained microscopists. Arithmetic means were calculated and expressed as eggs per gram of stool (EPG). Results were categorized as light (1–100 EPG), moderate (101–399 EPG), and heavy-intensity (≥ 400 EPG) *S. mansoni* infections.³² Observation of soil-transmitted helminth (STH) eggs (*Ascaris lumbricoides*, *Trichuris trichura*, and hookworm) was recorded as positive or negative and was not quantified.

Treatment. Treatment with a single dose of albendazole (400 mg) and a three-day course of Coartem (artemether [20 mg/dose] and lumefantrine [120 mg/dose]) was provided for STH and malaria infections, respectively, as needed. Treatment with iron supplementation was provided for persons with severe anemia according to the Kenya National Clinical Guidelines for Nutritional and Hematologic Conditions.³⁰ Current WHO treatment guidelines for schistosomiasis control were followed. Given the high prevalence of *S. mansoni* infection reported by Verani and others,²⁸ community-wide distribution of praziquantel was conducted. Treatment was offered to all eligible residents, including children and adults not enrolled in our study. Praziquantel was dosed by weight (single dose of 40 mg/kg) and was administered by qualified study personnel.

Follow-up data collection. Six months after treatment, follow-up data were collected from enrolled participants by using questionnaires, measurements, and laboratory testing using the same methods as baseline collections. Similar to at baseline, pregnant women were excluded from all assessments. Quality of life was evaluated by using the WHOQOL-BREF, and scores were calculated for each of the four domains. Height, weight, and mid-upper arm circumference were recorded. One blood sample was collected by finger stick to assess anemia and malaria infection status. Serum was collected and stored at -20°C but no antibody testing was performed. One urine sample was collected to assess CCA. Three stool samples collected on separate days were checked for *S. mansoni* and STH eggs. Persons with evidence of *S. mansoni* eggs in stool and/or presence of CCA were classified as positive for *S. mansoni* infection. Treatments with iron supplements, Coartem, praziquantel, and albendazole were provided as necessary.

Data handling and analysis. Questionnaire data were collected on personal digital assistants that were programmed using Visual CE (Syware, Inc., Cambridge, MA). Laboratory results were entered into a Microsoft Excel spreadsheet (Microsoft; Redmond, WA). All study data were maintained in Microsoft Access (Microsoft, which served as the main study database. Data were analyzed by using SAS version 9.3 (SAS Institute Inc., Cary, NC). Simple frequencies were calculated for prevalence estimates and other percentages reported. A sign test was used to determine whether the CCA intensity decrease from baseline to the second day was significant. For other statistical comparisons, generalized estimating equation models were used to control for correlation within compounds. Because side effect scores or QOL scores were not normally distributed, these variables were dichotomized for analysis. Side effect score was dichotomized by using a cutoff of five,

and domain scores were dichotomized by using the overall medians of these scores for each domain (13.7, 14.7, 16.0, and 11.5 for domains one through four, respectively). Log binomial models were used for all dichotomous outcomes so that prevalences and prevalence ratios could be estimated.

RESULTS

Schistosoma mansoni infection. At baseline, 724 adults (age range = 18–85 years) were enrolled and provided responses to the WHOQOL-BREF questionnaire. Because multiple visits to each household were required, it took approximately six months to complete data collection. Of those enrolled, 583 (80.5%) persons provided at least one stool sample for analysis by Kato-Katz, 597 (82.4%) persons provided a urine sample for CCA testing, and 571 (78.9%) persons provided stool and urine. The overall prevalence of *S. mansoni* infection was 73.2% by stool examination, 75.4% by CCA, and 82.3% by either stool examination or CCA. Among stool-positive persons, 184 (43.1%) had light-intensity infections, 116 (27.2%) had moderate-intensity infections, and 127 (29.7%) had heavy-intensity infections. The numbers (and proportions) of CCA-positive persons with low (1+), moderate (2+), and high (3+) intensity infections were 161 (35.8%), 146 (32.4%), and 143 (31.8%), respectively. In addition, of the 573 serum samples sera evaluated by using the schistosome adult worm protein ELISA, 424 (74.0%) were positive for *S. mansoni* antibodies (Table 1).

Two days after treatment, 455 (76.2%) persons who provided urine at baseline provided another urine sample for CCA testing. One hundred twelve persons who were negative at baseline remained negative. For infected person, urine CCA was significantly reduced within two days after treatment ($P < 0.001$), and light infections were more likely to become negative. A decrease in CCA band intensity was observed in 255 (74.3%) infected persons, 101 (39.6%) of whom became CCA negative. Of the remaining 88 infected persons, no change in CCA band intensity was observed in 76 (86.4%) persons, 41 (53.9%) of whom had low intensity (1+) infections. Among infected and non-infected persons, an increase in CCA band intensity was observed in 12 (13.8%) persons.

Non-S. mansoni infections and morbidities. Independent variables that could potentially impact QOL are shown in Table 2. Of those enrolled and tested, a high proportion (58.8%) of persons was anemic. One-quarter of those tested was infected with at least one STH and 15.8% of those tested for HIV were positive. In contrast, a low proportion (3.0%) of those tested by blood smear was positive for malaria.

Six-month follow-up. Six months after treatment with praziquantel, 409 (56.5%) of the persons originally enrolled in the study provided responses to the same WHOQOL-BREF questionnaire administered at baseline. The significant loss to follow-up was primarily caused by permanent displacement of the residents because an airport runway was constructed through the village. Of those who were available for follow-up, 332 (81.2%) provided stool for examination by Kato-Katz, 358 (87.5%) provided urine samples for testing by CCA, and 314 (76.8%) provided stool and urine. There was a significant decrease ($P < 0.001$) in *S. mansoni* infection prevalence and intensity by both methods when compared with baseline (Table 1). Of the 138 persons who were positive by stool examination, 68.1%, 21.7%, and 10.1% had light, moderate,

TABLE 1
Prevalences of demographic traits and *Schistosoma mansoni* infection status*

Characteristic	Trait	No. positive/no. tested (%)	
		Baseline (n = 724)	Follow-up (n = 409)
Demographic	Mean age (range in years)	33.4 (18–85)	36.0 (18–85)
	Male sex	339/724 (46.8)	171/409 (41.8)
<i>S. mansoni</i> infection status	<i>S. mansoni</i> egg+	427/583 (73.2)	138/332 (42.4)
	Light intensity (1–100 EPG)	184/427 (43.1)	94/138 (68.1)
	Moderate intensity (101–399 EPG)	116/427 (27.2)	30/138 (21.7)
	Heavy intensity (≥ 400 EPG)	127/427 (29.7)	14/138 (10.1)
	CCA+	450/597 (75.4)	184/358 (51.4)
	Low intensity (1+)	161/450 (35.8)	117/184 (63.6)
	Moderate intensity (2+)	146/450 (32.4)	53/184 (28.8)
	High intensity (3+)	143/450 (31.8)	14/184 (7.6)
	<i>S. mansoni</i> egg + or CCA+	470/571 (82.3)	188/314 (59.9)
	Antibody	424/573 (74.0)	NA

* EPG = egg per gram (of feces); CCA = circulating cathodic antigen; NA = not available.

and heavy intensity infections, respectively. Similarly, of the 184 persons positive by CCA, 63.6%, 28.8%, and 7.6% had low, moderate, and high intensity infections, respectively (Table 1). Antibody testing was not repeated at the six-month follow-up.

Similar to the decrease in *S. mansoni* infection levels, there was a significant decrease in the prevalence of anemia from 58.8% at baseline to 39.4% at follow up ($P < 0.001$). Comparably, STH infections decreased from 25.0% to 15.4% ($P < 0.001$). In contrast, there was a significant increase in malaria prevalence ($P = 0.002$) from 3.0% at baseline to 8.4% at follow-up (Figure 1).

WHOQOL-BREF scores. At baseline there was no association between *S. mansoni* infection status and WHOQOL-BREF scores for any of the four domains. A significant association ($P = 0.003$) between anemia and QOL scores for the physical domain was observed, but no associations were found with the other domains. In addition, significant associations were observed between socioeconomic factors and the psychological ($P = 0.008$), social ($P = 0.039$), and environmental ($P < 0.001$) domains. No significant associations were seen between HIV, malaria, or STH infection status and QOL scores.

Six months after treatment, there were significant increases in the proportion of higher WHOQOL-BREF scores for all domains for *S. mansoni*-infected persons. However, a significant increase in the proportion of higher scores was also observed in persons not infected with *S. mansoni* at baseline (Table 3). At follow-up, there were no associations between anemia, HIV, malaria, or STH infection and QOL scores for any domain.

Side effects to treatment with praziquantel. All ten side effects that comprised the composite score were reported by *S. mansoni*-infected and non-infected persons, but were reported more often by infected persons. Those persons with low intensity infections assessed by stool examination reported

significantly more side effects than non-infected persons ($P = 0.016$). Severity of side effects increased as intensity of infection increased, and those with moderate and heavy intensity infections reported significantly more side effects than non-infected persons ($P < 0.001$) (Figure 2). Overall, regardless of *S. mansoni* infection status, the most common side effect reported was fever, but relatively few persons reported constipation (Figure 3). Diarrhea and abdominal pain were also commonly reported. Although only 16% of persons who were negative by stool examination reported having diarrhea when treated, 72% of those with high intensity infections reported the same side effect. Similarly, 28.6% of uninfected persons reported having abdominal pain, and nearly 69% of heavily infected persons reported having pain after praziquantel treatment (Figure 3).

DISCUSSION

Public health impact of early schistosomiasis control programs focused on severe morbidities, such as hepatosplenomegaly or hepatic fibrosis.^{3–5} Recognizing that many infected persons may not experience advanced stages of disease, programs began to incorporate measurement of subtle morbidity markers such as anemia,^{6,7} and the importance of subtle morbidity indicators has started to gain more attention.^{33,34} However, currently, the impact of treatment in *S. mansoni*-endemic areas is monitored primarily by assessing changes in infection prevalence and intensity and may not truly reflect the impact of treatment on health.^{11–14} We carried out a study in an area to which *S. mansoni* is highly endemic to assess whether a standardized QOL instrument (WHOQOL-BREF) was an effective tool for measuring morbidity caused by schistosomiasis and the impact of mass treatment with praziquantel.

TABLE 2
Prevalences of non-*Schistosoma mansoni* infections and morbidities*

Characteristic	Trait	No. positive/no. tested (%)	
		Baseline	Follow-up
Infection status	HIV+	63/399 (15.8)	NA
	Malaria+	13/437 (3.0)	28/334 (8.4)
	STH+	146/583 (25.0)	51/332 (15.4)
Morbidity	Anemia (hemoglobin level) female: < 12 g/dL; male: < 13 g/dL)	351/597 (58.8)	141/358 (39.4)

* HIV = human immunodeficiency virus; NA = not available; STH = soil-transmitted helminth.

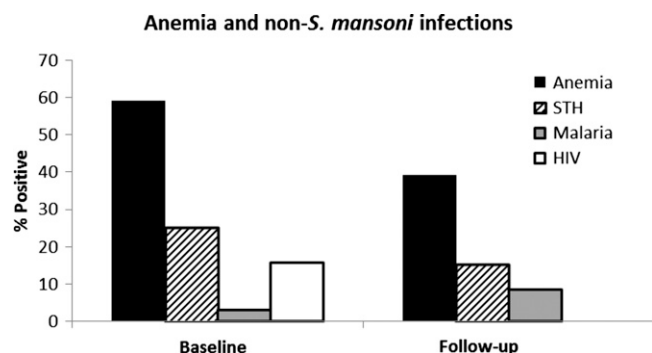


FIGURE 1. Prevalence of anemia and non-*Schistosoma mansoni* infections at baseline and six months after treatment. STH = soil-transmitted helminth; HIV = human immunodeficiency virus.

As expected, rates of *S. mansoni* infection were high in this lakeside community. Prevalences of infection determined by stool examination, CCA, and ELISA were nearly identical; a finding consistent with previous studies suggesting that the rapid antigen detection test may be an alternative to stool examinations in areas where *S. mansoni* infection is common.^{12–14,35} Significant reductions in *S. mansoni* prevalence and intensity of infection were observed after treatment with praziquantel, but infection prevalence remained near the threshold at which mass treatment of the community was warranted. However, there was a shift from a relatively equal distribution of intensity of infections to primarily light intensity infections six months after treatment. A statistically significant decrease in anemia was also observed six months after treatment, which may have been the result of a combination of factors, including treatment with anthelmintic drugs and iron supplementation. However, a high proportion of persons was still anemic at follow-up. It is unlikely that the observed anemia was primarily attributable to malaria because malaria prevalence was low at baseline (3.0%) but higher (8.4%) at follow-up. The persistence of *S. mansoni* infections in the community may have contributed in part to the observed anemia. Although anemia is often considered of greater concern among children, its impact in adults should not be ignored.³⁴

Previous studies have demonstrated associations between severity of schistosomiasis and perceived QOL. Although it is likely that chronic diseases such as schistosomiasis can impact perceived QOL, the data from our study showed no association with infection status at baseline. When the WHOQOL-BREF was re-administered six months after treatment, significant increases in QOL scores were observed regardless of baseline *S. mansoni* infection status. It is possible that in areas where

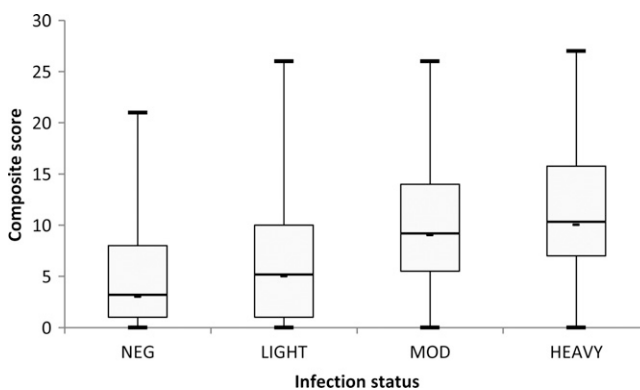


FIGURE 2. Mean composite scores for reported side effects. In this plot, boxes represent the 25th–75th percentile and the line in the box represents the median. Whiskers represent the maximum and minimum composite scores. *Schistosoma mansoni* infection status was defined by Kato-Katz. NEG = negative; MOD = moderate.

baseline *S. mansoni* prevalence is high, as was the case in Usoma, one round of treatment may not be sufficient to capture any differences in perceived QOL between *S. mansoni*-infected and non-infected persons. Although there was a significant decrease in *S. mansoni* prevalence six months after treatment, nearly half of the persons were still infected or had been re-infected at follow-up. Differences may have been observed between the two groups if the same study had been conducted after multiple rounds of treatment. It appears that the WHOQOL-BREF may have limitations in its utility for measuring specific morbidity caused by schistosomiasis.

The WHOQOL-BREF was designed to give a measure of QOL but was not designed to detect the benefits of schistosomiasis control programs. The questions included broad health-related questions, but none specifically to address infection with *S. mansoni*. In addition, there was a rigorous translation process required to use this instrument. During this process, we discovered that some of the questions may not have been culturally relevant to the participants from our study area. Many of the participants had either a difficult time understanding particular questions or had a reluctance to answer certain questions. However, it was not permitted to exclude or alter any questions when using the instrument. Furthermore, a placebo effect cannot be ruled out. The presence of any health intervention may have been enough to impact the perceived QOL. In addition, the construction of the new airport may have impacted perceived QOL. Although a significant proportion of our study population was permanently displaced by the construction of the new runway, it is possible the remaining residents were positively affected by the

TABLE 3
Proportion of WHOQOL-BREF scores above the median for each domain at baseline and follow-up*

Domain	Median score	% <i>Schistosoma mansoni</i> -infected persons with scores above median			% Non-infected persons with scores above median		
		Baseline	Follow-up	P*	Baseline	Follow-up	P
Physical	13.7	50.3	62.2	< 0.001	46.2	66.0	< 0.001
Psychological	14.7	42.2	60.6	< 0.001	45.5	68.7	< 0.001
Social	16.0	46.2	59.7	< 0.001	44.3	58.9	0.024
Environmental	11.5	36.2	65.6	< 0.001	37.2	62.4	0.001

*P values were calculated using log binomial models. WHOQOL-BREF = short form of the World Health Organization Quality of Life questionnaire.

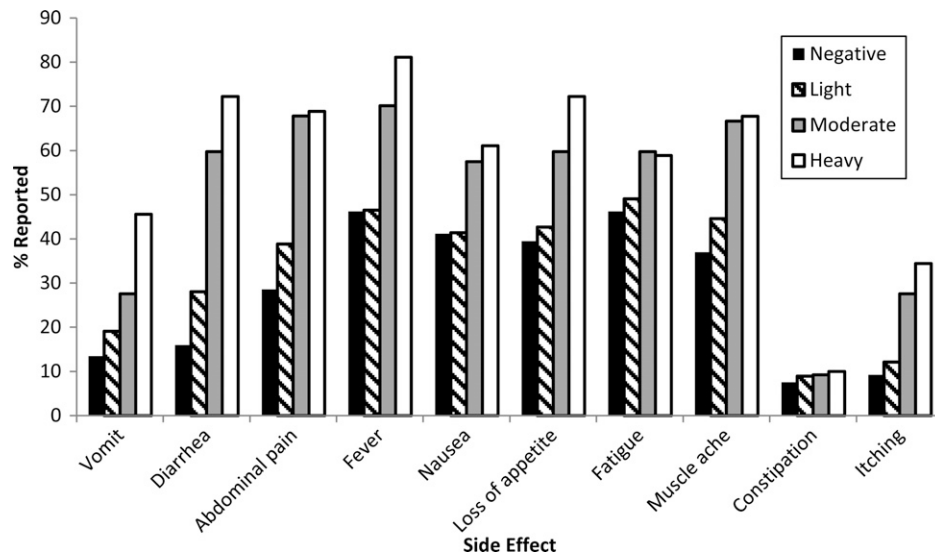


FIGURE 3. *Schistosoma mansoni* infection intensity by Kato-Katz and percentage of reported side effects.

introduction of the new facility. Perhaps there were more opportunities available to these residents that in turn impacted perceived QOL.

We observed a strong association between intensity of *S. mansoni* infection and the number and severity of side effects experienced after praziquantel treatment. It is widely acknowledged that praziquantel treatment is an effective strategy for control programs and compliance with treatment is essential for defining success. Side effects associated with treatment have the potential to dissuade persons from future participation. As large-scale control programs develop, it is important to convey clear messages about potential side effects and the benefits after treatment. In our study, side effects were transient, and we received anecdotal reports of improved capacity for daily activities after treatment. These results suggest that developing health questions specific for schistosome infections may yield informative data.

In areas of high prevalence and intensity of *S. mansoni* infection, the WHOQOL-BREF may not be adequate to detect the benefits of control programs. However, this does not exclude the possibility that an instrument could be developed specifically for schistosomiasis or other neglected tropical diseases. As control programs look to identify alternative methods for monitoring and evaluating the impact of mass drug administration, disease-specific QOL questionnaires may be an effective tool.

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